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AN EXPERIMENTAL PHARMACOLOGICAL APPRECIATION OF LEVITICUS XI AND DEUTERONOMY XIV *

DAVID I. MACHT

While engaged in an extensive research, which is still in progress, on the chemical and pharmacological properties of the blood and muscles of normal individuals and of patients afflicted with cancer, the writer became interested in investigating the comparative pharmacological actions of fresh muscle juices and of saline extracts of skeletal muscle tissues of different species of animals, both quadrupeds and birds. Inasmuch as zoological experiments with such extracts cannot be easily performed on account of protein reactions occurring after injections of such juices into animals and on account of bacterial and fungal contaminations, a new and novel approach to the problem was made by the special "phytopharmacological" methods employed by the author in the last thirty years (1, 2, 3). By phytopharmacology is meant the study of the action of drugs, poisons, toxins, sera, and various chemicals on living plant-physiological test objects, in contrast to animal or zoopharmacological test objects. By this method it has been found by the author and his co-workers that many toxic constituents can be detected in the blood and various body fluids of human beings which toxins cannot be readily demonstrated by animal experiments and even by ordinary physico-chemical methods. The simplest method employed for such work by the author is to study the effect on the root growth of seedlings of *Lupinus albus* grown in plant-physiological solutions containing the necessary salts and ions for their growth, with and without the addition of one or more per cent of the chemical to be investigated. Such seedlings grown under strictly controlled ecological conditions of light, temperature, etc., give very consistent results, statistically reliable. In this way, the author and his school have already discovered the presence of specific toxins in the blood of patients suffering from the very fatal disease emphygus (4), in patients afflicted with Pernicious Anemia (5), and in the blood of all psychotic patients (6). Such methods are at present employed in the research on the blood of normal and cancerous patients.

* Read before the annual meeting of The American Oriental Society, Washington, D. C., April 8, 1953.

In studying muscle extracts of fresh meats from various species of animals some very interesting findings were made. These are exhibited in the subjoined tables. To understand the significance of the tables one must bear in mind that the "phytotoxic index" means the ratio in percentages of root growth of *Lupinus albus* seedlings in a solution of unknown muscle juice dissolved in plant physiological saline to the growth of seedlings from exactly the same crop of plants grown in normal control solutions, at exactly the same conditions. The lower the index the more poisonous is the effect. An examination of the figures reveals data which are of considerable interest not only to the medical investigator but also to students of ancient Biblical literature.

It was found that muscle juices and saline extracts of skeletal muscles or "meats" from such domestic animals as the ox, calf, sheep, goat, and deer commonly employed as food, were practically non-toxic for the root

TABLE 1—QUADRUPEDS

PHYTOTOXIC INDICES OF 2% SOLUTIONS OF FRESH MUSCLE JUICES

Species of Animal	No. of Experiments	Index of Growth	Species of Animal	No. of Experiments	Index of Growth
Ox	20	91%	Swine	20	54%
Calf	20	82%	Rabbit	20	49%
Sheep	20	94%	Guinea Pig	20	46%
Goat	20	90%	Camel	20	41%
Deer (Venison)	20	90%	Horse	20	39%

growth of the *Lupinus* seedlings, i. e. did not inhibit their growth. On the other hand, the muscle extracts prepared in exactly the same way from the four quadrupeds specifically prohibited to be consumed as food in Leviticus XI and Deuteronomy XIV, namely, the hog, hare, coney, and the camel were very toxic for the seedlings. The coney is regarded by many Biblical scholars as closely related to the guinea pig. Camel meat was obtained by the writer directly from the Near East, shipped by air in a refrigerator. (Table 1)

Similar experiments with extracts of muscles from other quadrupeds, mostly wild ones, and beasts of prey were also found to be phyto-toxic. Specimens of fresh or frozen flesh were secured from the dog, cat, squirrel, white rat, ground hog, fox, opossum, hamster, black bear, and grizzly bear and rhinoceros. (Table 2)

Other experiments were made in exactly the same way with muscle extracts from various birds. Here again it was found that the extracts from the flesh of the chicken, the duck, goose, turkey, pigeon, and the quail were not toxic, while similar extracts from the flesh from birds of prey, for example, the owl, hawk, falcon, and the crow were quite toxic. (Table 3)

TABLE 2—QUADRUPEDS

PHYTOTOXIC INDICES OF 2% SOLUTIONS OF FRESH MUSCLE JUICES

Species of Animal	No. of Experiments	Index of Growth	Species of Animal	No. of Experiments	Index of Growth
Dog	10	62%	Fox (silver)	6	50%
Cat	10	53%	Opposum (<i>Didelphis virginiana</i>)	8	53%
Squirrel	6	43%	Hamster	4	46%
Rat (white)	8	55%	Black Bear (<i>Euarctos americanus</i>)	8	59%
Ground Hog (<i>Arctomys monax</i>)	6	53%	Grizzly Bear	8	55%
			Rhinoceros	8	60%

TABLE 3—BIRDS

PHYTOTOXIC INDICES OF 2% SOLUTIONS OF FRESH MUSCLE JUICES

Species of Animal	No. of Experiments	Index of Growth	Species of Animal	No. of Experiments	Index of Growth
Chicken	20	83%	Sparrow Hawk (<i>Falco parverius</i>)	6	63%
Duck (mallard)	10	90%	Red Tail Hawk (<i>Buteo borealis</i>)	8	36%
Goose (<i>Anser albifrons</i>)	6	85%	Owl	8	62%
Turkey	10	85%	Crow	10	46%
Pigeon	10	93%	Coot	8	88%
Quail (<i>Coturnix communis</i>)	20	89%	Wild Duck (<i>Aythya americana</i>)	8	85%
Canada Goose (<i>Branta canadensis</i>)	7	85%	Swan	6	87%

Of special interest were experiments made with muscle juices and also blood solutions obtained from many species of fishes. Fifty-four species of fishes were so far studied in regard to the toxicity of their meat extracts. It was found that the muscle extracts of those fishes which possess scales and fins were practically non-toxic, while the muscle ex-

TABLE 4
TOXICITY OF FISH MUSCLE EXTRACTS

No.	Common Name	Scientific Name	Phytotoxic Index %
1.	"Alewife"	<i>Pomolobus pseudoharengus</i>	82
2.	Banded drum	<i>Larimus fasciatus</i>	80
3.	Black bass	<i>Micropterus dolomieu</i>	80
4.	Black drum	<i>Pogonias cromis</i>	105
5.	Bluefish	<i>Pomatomus saltatrix</i>	80
6.	"Bonito"	<i>Auxis thazard</i>	78
7.	Bowfin	<i>Amia calva</i>	90
8.	Butterfish	<i>Poronotus triacanthus</i>	81
9.	Carp	<i>Cyprinus carpio</i>	90
10.	Catfish	<i>Ameiurus catus</i>	48
11.	Channel bass	<i>Sciaenops ocellata</i>	80
12.	"Chub"	<i>Chaenobryttus coronarius</i>	91
13.	Cod	<i>Gadus callarias</i>	90
14.	Croaker	<i>Micropogon undulatus</i>	90
15.	Eel	<i>Anguilla rostrata</i>	40
16.	Flounder	<i>Paralichthy dentatus</i>	83
17.	Flying fish	<i>Prionotus carolinus</i>	87
18.	Gambusia		89
19.	Goldfish	<i>Carassius auratus</i>	88
20.	Haddock	<i>Melanogrommus aeglefinus</i>	80
21.	Hake	<i>Urophycis regia</i>	98
22.	Halibut	<i>Phatysomatichthys hippoglossoides</i>	82
23.	Herring	<i>Clupea harengus</i>	100
24.	Kingfish	<i>Tarpon atlanticus</i>	83
25.	Menhaden	<i>Brevoortia tyrannus</i>	90
26.	Moonfish	<i>Vomer setipinnis</i>	51
27.	"Mullet"	<i>Frimyzon sucetta</i>	87
28.	Pike	<i>Esox americanus</i>	98
29.	Pompano	<i>Trachinotus carolinus</i>	110
30.	Porcupine fish	<i>Diodon hystrix</i>	60
31.	Porgy	<i>Stenotomus chrysops</i>	80
32.	Puffer	<i>Sphaeroides maculatus</i>	51
33.	Rainbow trout	<i>Salmo gairdneri irideus</i>	81
34.	"Robin"	<i>Lepomis gibbosus</i>	91
35.	Rock	<i>Roccus saxatilis</i>	100
36.	"Salmon trout"	<i>Cynoscion nebulosus</i>	96
37.	Sand flounder	<i>Lophonsetta maculata</i>	85
38.	Sand skate	<i>Pteroplates maclura</i>	59
39.	Smelt	<i>Menidia menidia</i>	90
40.	Sea bass	<i>Centropristes striatus</i>	103
41.	Shad	<i>Alosa sapidissima</i>	100
42.	Shark (dogfish)	<i>Mustelus canis</i>	62
43.	Silver squeteague	<i>Cynoscion nothus</i>	84
44.	Spadefish	<i>Chaetodipterus faber</i>	80
45.	Spanish mackerel	<i>Scomberomorus maculatus</i>	98
46.	Spot	<i>Leiostomus xanthurus</i>	80
47.	Stingaree	<i>Dasyatis say</i>	46
48.	Sturgeon	<i>Acipenser oxyrinchus</i>	87
49.	Toadfish	<i>Opsanus tau</i>	49
50.	Tuna, bluefin	<i>Thunnus thynnus</i>	88
51.	Weakfish	<i>Cynoscion regalis</i>	97
52.	White perch	<i>Pomoxis nigromaculatus</i>	81
53.	Whiting, Carolina	<i>Menticirrhus americanus</i>	84
54.	Yellow perch	<i>Perca flavescens</i>	87

tracts from fishes without scales and fins were highly toxic for the growth of *Lupinus albus* seedlings. Such fishes were catfish, eel, moonfish, puffer, skate, sharks, stingaree, toadfish, and porcupine fish (7). Similarly, studies on 1% solutions of blood from a number of fishes were found to give a similar difference in toxicity (8); the blood from fishes

TABLE 5

TOXICITY FOR LUPINUS SEEDLINGS FOR FISH BLOOD 1% SHIVE'S SOLUTION
FROM FISH WITH SCALES AND FINS

No.	Common Name	Scientific Name	Phytotoxic Index %
1.	Kingfish	<i>Tarpon atlanticus</i>	70
2.	Bumper	<i>Chloroscombus chrysurus</i>	74
3.	Butterfish	<i>Poronotus triacanthus</i>	80
4.	Sea Robin	<i>Lepomis gibbosus</i>	87
5.	Pike	<i>Esox americanus</i>	82
6.	Goldfish	<i>Carassius auratus</i>	80
7.	Chub	<i>Chaenobryttus gulosus</i>	75
8.	Carp	<i>Cuprimus carpio</i>	75
9.	Flounder	<i>Paralichthys dentitus</i>	75

TABLE 6

TOXICITY OF BLOOD FOR LUPINUS SEEDLINGS OF FISH WITHOUT SCALES AND FINS

No.	Common Name	Scientific Name	Phytotoxic Index %
1.	Skate	<i>Pteroplatea macdura</i>	60
2.	Sand Shark	<i>Carcharias littoralis</i>	31
3.	Hammerhead Shark	<i>Sphyrna zygaena</i>	34
4.	Puffer	<i>Spheroides maculatus</i>	44
5.	Stingaree	<i>Dasyatis say</i>	55
6.	Catfish	<i>Ameiurus catus</i>	59
7.	Eel	<i>Anguilla chrisypa</i>	50
8.	Porcupine Fish	<i>Diodon hystrix</i>	60
9.	Toad Fish	<i>Opsanus tau</i>	50

with scales and fins was but slightly inhibitory to the root growth of the seedlings, while the blood specimens obtained from a number of fishes without scales or fins were highly toxic. (Tables 5 and 6)

Quails are not toxic as may be seen from Exodus XVI. How then can we explain scientifically the poisoning by quail meat described in Numbers XI? This problem puzzled such ancient writers as Pliny, Lucretius,

Galen, and others. A most beautiful explanation is found in a historical *Archives de l'Institut Pasteur d'Algérie*, XIX, June 1941, pp. 161-162 (9). It has been found that quails of Near East returning from their migration fly over terrains in which various poisonous plants are growing, among them hellebore, *Aconitum napellus*, and especially abundant, *Conium maculatum* or hemlock. The birds gorge themselves with the berries and seem to be markedly immune or resistant to the poisonous products. Their flesh however, becomes very poisonous for higher animals as was shown by actual experiments of Professor Sergent. Thus without detracting from the Biblical account of retribution the poisoning can be explained on physical grounds.

The observations described above corroborate the impression repeatedly made on the author in his investigations as a physician (M. D. Johns Hopkins, 1906), as an experimental biologist (Member of Society for Experimental Biology and Medicine), and as Doctor of Hebrew Literature (Yeshiva University, 1928) that all allusions of the Book of Books, to nature, natural phenomena, and natural history, whether in the form of factual statements or in the form of metaphors, similes, parables, allegories, or other tropes are correct either literally or figuratively. This fact has impressed not only the writer of the present paper, but also many eminent scientists, such as Moses Maimonides, Waldemar Haffkine, Mathew F. Maury, Robert A. Millikan, Howard A. Kelly, and many others. Such being the extraordinary concordance between the data of the Scriptures and many of the modern and even most recent discoveries in both the biological and physico-chemical sciences, every serious student of the Bible will, I believe, endorse the assertion of Sir Isaac Newton, that "The Scriptures of God are the most sublime philosophy. I find more such marks of authenticity in the Bible than in profane history anywhere."

Comprehensive concordances and extensive commentaries have been written on the works of Shakespeare. Similarly, other commentaries and appreciations have been published dealing with the works of Dante, and Goethe, and other great writers. That is as it should be, for their works contain more than is dreamt of by ordinary mortals. History informs us that the poet Thomas Gray spent eight years perfecting the marvelous lines and thoughts expressed in his "Elegy." Shall we deny the same homage and study to the inspired authors, — prophets, poets, philosophers, naturalists, moral teachers, — of the Book which has alone remained the Best Seller of all civilized ages? The answer given by men of science and medicine, who have had sufficient courage, breadth of vision, and initiative

to master the humanities along with their acquired store of scientific lore, those men and women who live a three-dimensional life instead of the flat ingrown two-dimensional one of the so-called "specialists" is unequivocal. Every word in the Hebrew Scriptures is well chosen and carries valuable knowledge and deep significance.

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